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Evolutionary roots of sound symbolism. Association tasks of animal properties with phonetic features

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ABSTRACT

Contradicting Saussure's arbitrariness of the linguistic sign, sound symbolism – the systematic association of sounds with meanings – is consistently found across languages. It may have offered a ground for our ancestors to develop an initial communication system, and later move toward symbolic signs. We tested sound symbolic associations in French between phonetic segments or phonetic features and various attributes of animals (size, dangerousness…). A first experimental setting revealed no significant association, while a second did. These associations furthermore do not appear in French animal names. We discuss these results in the light of scenarios of language origins and evolution.

1. Background: sound symbolism and the origins of language

1.1. Studies on sound symbolism

1.1.1. How arbitrary are linguistic signs?

For a century, theoretical linguistics has built on Saussure's heritage about the arbitrariness of linguistic signs. In doing so, it took for granted that the relation between the 'signifier' and the 'signified' is arbitrary and conventionalized (De Saussure, 1916). This undermined the possibility of what philosophers of language have called 'natural' or 'motivated' signs, i.e. signs underpinned by some non-arbitrary principle(s) of association.

Although a major part of the lexicon of a language clearly relies on arbitrary associations between a mental representation and an 'acoustic image', there is however evidence of the existence of motivated signs in human languages. Most of them – if not all – use at least some signs that present a non-arbitrary relation between their sounds and their meaning. In onomatopoeia for example, an iconic relationship exists between the phonetic shape of the word and the sound emitted by what it refers to, e.g. the sound produced by an animal. In ideophones or phonaestemes, a strong similarity of shape between the signifier and the signified may not exist, but recurrent principles of association do, as for example when words related to 'vision' and 'light' in English often contain the phoneme cluster /gl/ (Schmidtke et al., 2014). The frequency of occurrence of these phenomena varies across languages, with some languages such as Japanese being very rich in sound symbolic words (Kantartzis et al., 2011).

A few conceptual differences need to be highlighted. First, motivation and iconicity may be synonyms in some texts, but while iconic signs are motivated, not all motivated signs are necessarily iconic. Second, Ahlner and Zlatev (2010) stress that

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the notion of convention has often been wrongly equated to arbitrariness. However, that non-arbitrary sign be conventionalized in a population of speakers is a perfectly viable option.

Sound symbolism is the expression commonly used to refer to non-arbitrariness. According to Ohala (1997), this is 'the term for a hypothesized systematic relationship between sound and meaning'. Different articulatory or acoustic properties of speech sounds may be associated to various *ontological*[1] properties of objects or events.

The previous considerations relate to oral languages, but sign languages should not be left aside. Indeed, they are known to contain a large number of non-arbitrary signs in addition to arbitrary ones. For many, the *visual* shape of the signifier resembles those of the signified, in a similar way the *acoustic* shape of a vocal sign may resemble the sound(s) made by a referent.

1.1.2. Evidence of sound symbolism

Beyond the previous evidence readily available in the lexicon of many languages, Sapir (1929) showed experimentally nearly a century ago that phonemic contrasts could also be mapped to physical and more generally ontological properties of things. Among others, he explained how English speakers associated [a] with large things, and [i] with small ones. His investigations were the first steps of a series of experimental studies that gave further voice to the idea of non-arbitrariness in language. To this day, two main experimental protocols have been employed: *association tasks* and *phonetic judgment tasks*.

A famous example based on an association task is the so-called '*bouba-kiki*' effect. It consists in the simultaneous presentation of two shapes, one spiky and the other curvy, and two pseudo-words 'bouba' and 'kiki' – in the original study, Köhler (1947) actually used 'maluma' and 'takete'. According to Ramachandran and Hubbard (2001), speakers of different languages and cultures are overall very consistent in their choice: 95% of surveyed people choose to associate the curvy shape with 'bouba' (or 'maluma') and the spiky one with 'kiki' (or 'takete'). Although this study has often been cited after its publication, it does not offer details about the experimental setting, the number of people surveyed, their gender, the language(s) they spoke etc. Other scholars have however refined the basic setting upon two particular aspects: on the one hand the phonetic differences between the pseudo-words, and on the other hand the explicit nature of the task. Regarding phonetic differences, subsequent studies implemented better control of the phonetic content of the pseudo-words in order to disentangle the role of consonants and vowels – if bouba is associated with round shape, is it because of the [b] or of (one of) the vowel(s)? This implied using only one vowel and one consonant, and also descending at the level of phonetic features (Nielsen and Rendall, 2011; Nobile, 2015; Ozturk et al., 2013). Regarding the task itself, the *bouba-kiki* experiment is very explicit in the sense that subjects can immediately notice the difference(s) between the two shapes, and between the two pseudo-words. This can induce the use of elaborate strategies which depart from the more intuitive judgments of sound symbolism made by subjects in other contexts. To avoid such strategies, Westbury (2005) used a lexical decision task, which was much more implicit in its design, and still obtained significant associative effects.

Other experiments are based on phonetic judgment tasks. This is how Sapir and his student Newman shed light on the relations between some phonemes and some ontological properties of things (Newman, 1933). In reviews of such studies (Nuckolls, 1999; Ozturk et al., 2013; Spector and Maurer, 2013), as well as in cross-linguistic surveys of the relevant vocabulary (Nuckolls, 1999; Tanz, 1971), different types of correspondences are reported across languages: some phonemes relate to distance, others to brightness or elevation, others yet to properties such as nice, bitter etc. For example, Fónagy (1983) collected subjective judgments about phonemes from Hungarian speakers. He found that [i] is 'little', 'agile', 'nice' and that [u] is 'big', 'corpulent', 'obtuse', 'sad', 'dark', 'strong', 'bitter'. The same author also compared the distribution of phonemes in poems judged as 'aggressive' or 'tender', and found that aggressive poems contained a greater proportion of voiceless plosives like [t, k], whereas tender ones included more sonorants like [m, n, l] (Fónagy, 1961).

Berlin (1994) noted some specific phoneme distributions in animal names in south-American languages like Huambisa. In this language, names of fish contain more phonemes and syllables of low acoustic frequency ([a], [ku], [ka]), more nasals ([n], [m]) and more continuants ([s], [r]). Names of birds contain more phonemes and syllables of high frequency ([i], [pi], [t], [ts]), stops and affricates (with some differences between initial and final positions in words). Moreover, the frequency of [i] correlates with size across species: the names of the smaller fish and birds contain more [i] and the names of the bigger ones more [e], [a] and [u]. These distributions are also found in three other languages, two from South America, and one from Mexico. To elaborate on these findings, Berlin conducted an experiment with English-speaking students. They were presented a list of pairs of Huambisa names (explicitly one bird and one fish), and had to indicate which one referred to a bird. Their accuracy rate reached 8% above chance threshold and was highly statistically significant. This meant that English speakers could most often guess the biological class of an animal only from the phonetic composition of its name in Huambisa. Cross-culturally again, experiments with the Himba people of Northern Namibia revealed that they produce the same answers as Westerners for the bouba/kiki association task, but differ from them when it comes to associating angular and round shapes with water carbonation or food bitterness (Bremner et al., 2013). Himba have had little contact with Western culture, and the study shows that cross-modal associations are not necessarily universal.

Some of these associations appear early during development. In particular, Ozturk et al. (2013) showed that 4-month infants consistently distinguish between congruent and incongruent sound-shape mappings in a looking time task. That

[1] We use this term to encompass physical properties such as size, shape or color, as well as properties such as dangerousness, attractiveness, beauty, value etc.